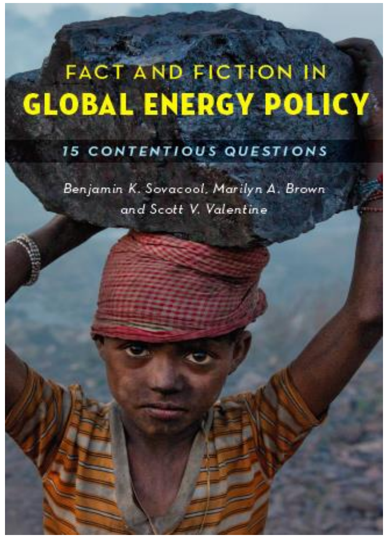
Topical Areas and Problems for the Geographical Sciences Committee: The Energy and Climate Nexus



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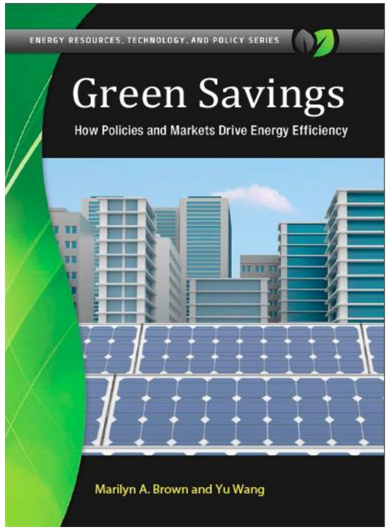
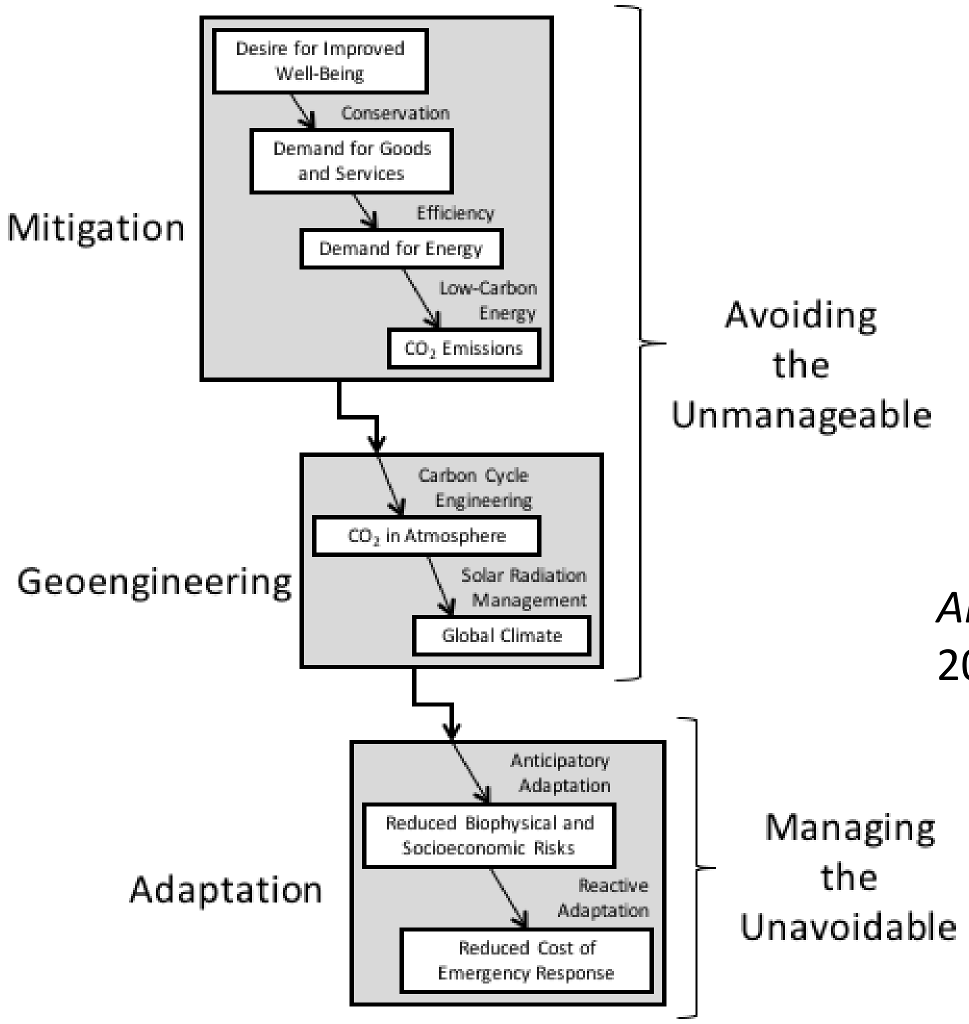


Fact and Fiction in Global Energy Policy by B. K. Sovacool, M.A. Brown, & S. Valentine, Johns Hopkins University Press, 2016.

July 12, 2016

Green Savings: How Policies and Markets Drive Energy Efficiency by M.A. Brown and Yu Wang, Praeger, 2015.

Mitigation, geo-engineering, and adaptation are correlated but distinct responses to climate change



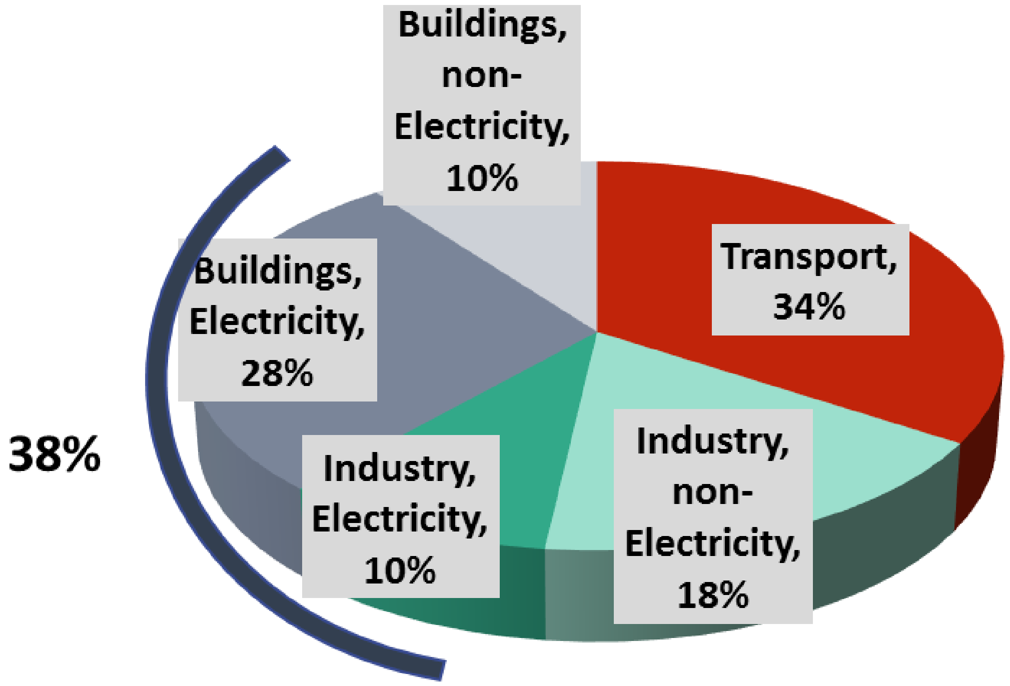
Source: Brown, Marilyn A. 2010. "The Multiple Dimensions of Carbon Management: Mitigation, Adaptation, and Geo-engineering," *Carbon Management,* 1(1): 27-33.

America's Climate Choices, National Academies, 2008-2011

The U.S. Clean Power Plan (CPP)

- The electricity sector is the source of 38% of U.S. CO_2 emissions
- The Clean Power Plan is designed to cut this sector's CO_2 emissions in 2030 to 32% below 2005 levels
- The electricity sector is rapidly transforming with lots of associated issues:
  - ✓In 2015: natural gas=coal
  - ✓soon: wind + solar =hydro

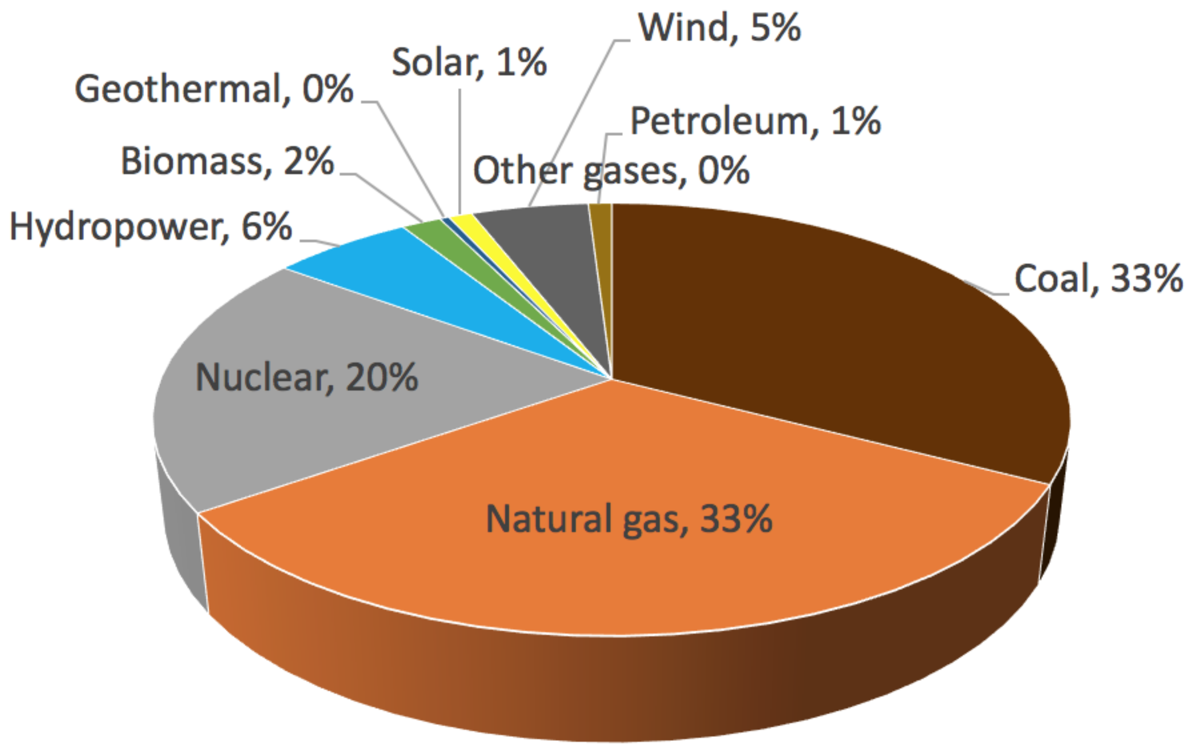
U.S. CO_2 Emissions from the Energy Sector (2014)



The CPP has Numerous Under-Studied Environmental Justice Issues

- EJ – the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies.

- The transition to a clean energy future has numerous spatial EJ issues



Emanuele Massetti, Marilyn Brown, et al. *Environmental Quality and the U.S. Power Sector: Air Quality, Water Quality, Land Use and Environmental Justice,* Oak Ridge National Laboratory, ORNL/SPR-2016/772 (2016).

Time-Geography Perspectives are Critical

Table 1 | Changes to reduce fossil fuel consumption at various social and temporal scales.

Social scales and roles	Temporal scales		
	Short-term (moments to days; for example changing usage of energy-consuming equipment)	**Intermediate (weeks to decades; for example adopting equipment with lower FFC)**	**Long-term (generational, societal transformation)**
Households as energy consumers.	Alter indoor temperature. Turn off lights and appliances not in use. Drive more smoothly. Share transportation. Shift to lower-FFC transport modes.	Replace appliances, HVAC (heating, ventilation and air conditioning) systems and motor vehicles with energy-efficient models. Insulate homes. Adopt photovoltaic systems. Choose small, efficient housing units, with proximity to public transit, shopping and work, when relocating.	Demographic transition to lower birth rates. Multi-generational households.
Household consumption affecting FFC in supply chains.	Purchase low-carbon-footprint foods and services.	Purchase low-carbon-footprint durable products.	Reverse preferences for large, suburban homes, large cars and distant holidays as expression of well-being.
Organizations as energy consumers.	Induce employees to reduce energy use (for instance, in offices, minimize use of task lights, computers, auxiliary heating/cooling devices). Reduce motorized business travel (for example by using video conferencing). Assign staff 'energy champion' responsibilities. Manage production systems in response to real-time price signals.	Make reducing FFC a strategic part of core business operations. Replace lighting and HVAC systems, equipment and motor vehicles with energy-efficient models. When relocating, rent or procure low FFC buildings. Adopt photovoltaic systems. Change work styles to accommodate a broader range of thermal conditions (for example, Japan's Super Cool Biz programme[91]).	Change core business offerings to align with climate challenges (for example BP's short-lived 'beyond petroleum' experiment[89], or Interface Carpet's goal of carbon neutrality[90]).
Organizations as providers of goods and services.	Find lower-footprint supply sources. Inform customers on how to use products and services offered in an energy-efficient way. Reduce FFC in the production chain.	Make reducing FFC a strategic part of core business offerings. Support and train staff in systems thinking and sustainability. Redesign products for lower energy requirements. Elect to manufacture, market and service low-FFC products.	Develop lower-carbon industry-wide standards (for instance, carbon labelling schemes for suppliers).
Large-scale social systems.	Improve crisis responses to power outages and fuel shortages.	Adopt policies to encourage and assist lower-FFC actions in households and organizations. Create institutions and norms for lower-FFC actions in groups of organizations.	Improve public transport system. Design communities to make non-motorized travel easier. Change norms for socially desirable housing, vehicle types, workstyles and work practices.

Stern, Paul C., Kathryn B. Janda, Marilyn A. Brown, Linda Steg, Edward L. Vine, and Loren Lutzenhiser. 2016. "Opportunities and insights for Reducing Fossil Fuel Consumption by Households and Organizations" *Nature Energy,* DOI: 10.1038/NENERGY.2016.43, May.

Polycentric Energy Governance is Promising & Complex

Polycentric Governance
(Ostrom et al., 1961)

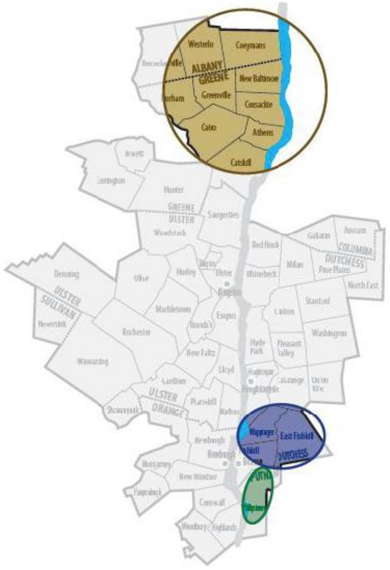
- Common pool resources and collective action problems
- Multiple centers of decision making & overlapping authorities
- Interactions between governance levels

- **Polycentric Energy Governance** (Goldthau, 2014; Pasqualetti & Brown, 2014; Sovacool, 2011)
  - Energy infrastructure system often spans multiple and interconnected regulatory scales
- **Environmental Federalism** (Shobe and Burtraw, 2012)
  - State-federal tension

How do different layers of government work together to influence technology diffusion in the U.S.?

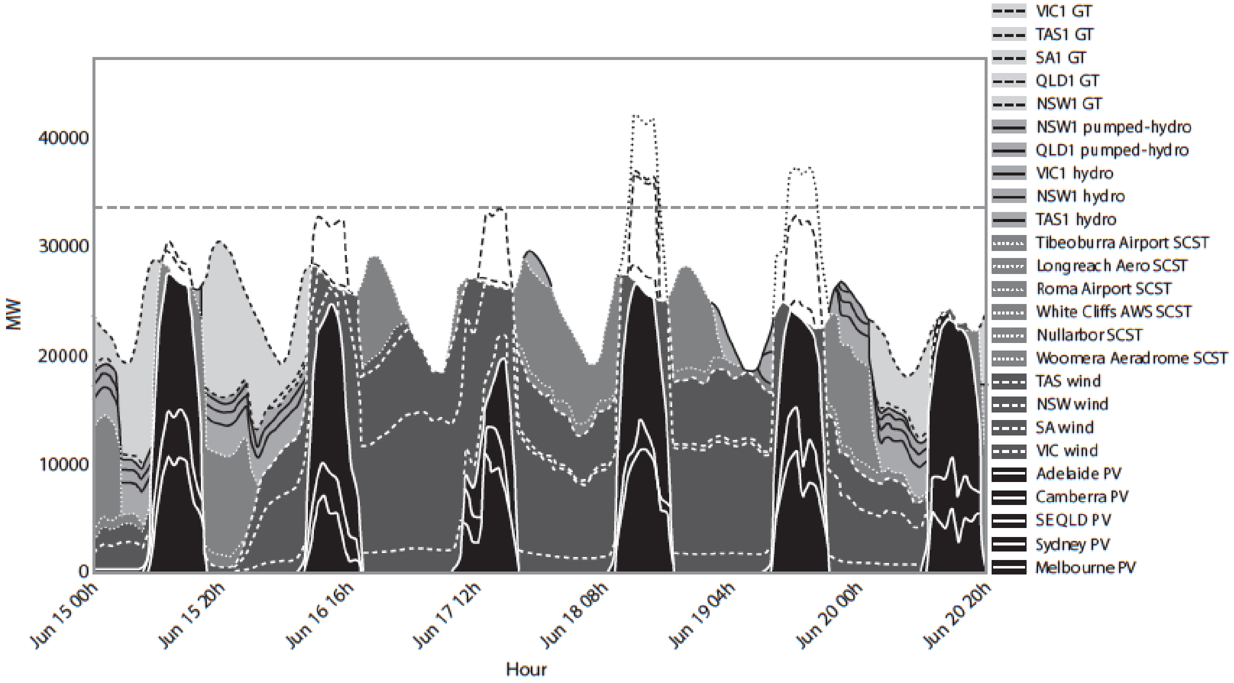
Geospatially Targeted Demand Management: Dealing with the "California Duck Curve"

- Deployed into specific zones
- Dispatched to address local constraints
- Cost-effective alternatives to transmission and distribution infrastructure upgrades



comverge
energy made better

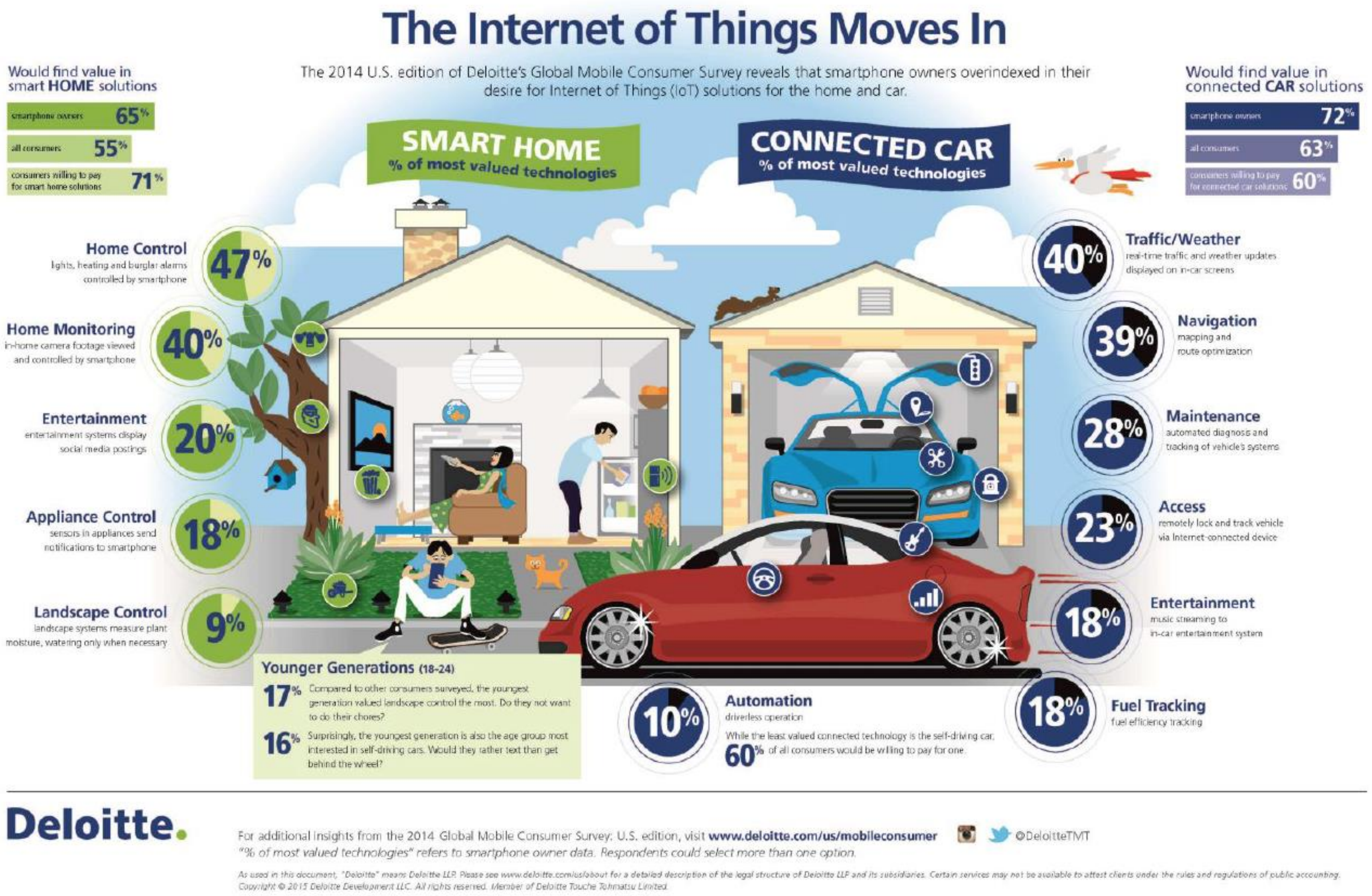
Some behavioral issues: rebound effect and rational inattention



Variations in Renewable Electricity Supply and Demand for Australia, 2010

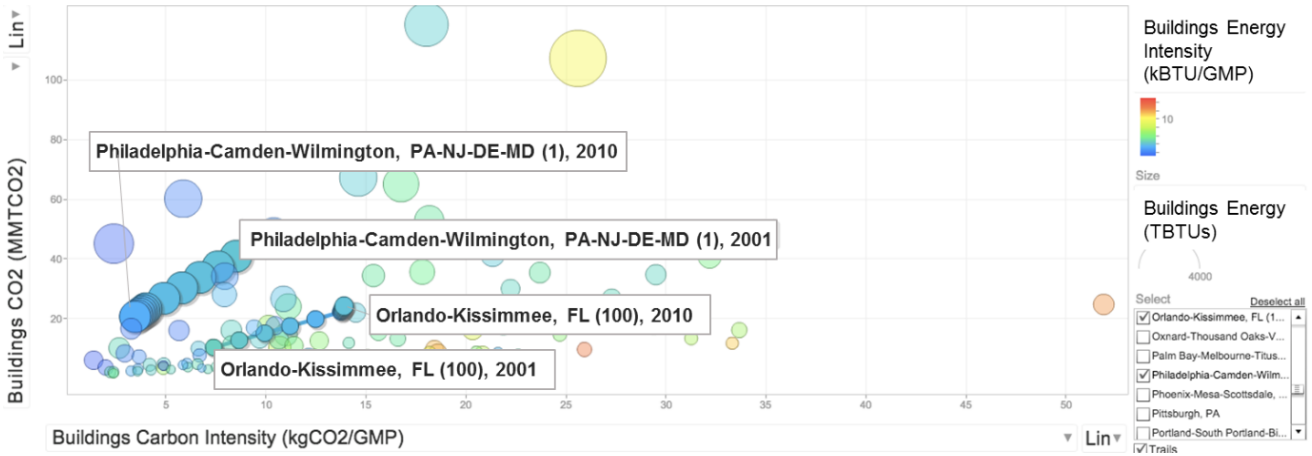
Sovacool, Brown, and Valentine. 2016. *Fact and Fiction in Global Energy Policy*

Internet of Things and Transactive Energy: Implications of Digital Control and Distributed Energy

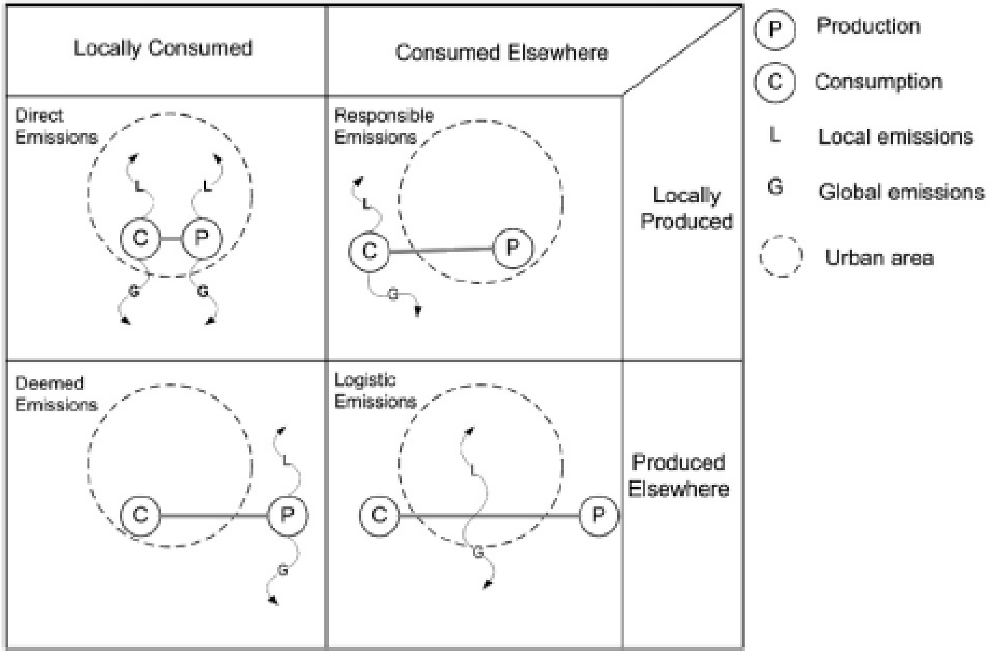


Estimating Carbon Footprints Requires Geoscientific Frameworks

Figure 2: Metros with the Least (Orlando) and Most (Philadelphia) Improved Buildings Carbon Footprints



Brown, Marilyn A., and Matt Cox. 2015. “Progress in Energy and Carbon Management in Large U.S. Metropolitan Areas, Energy Procedia 75, 2957 – 2962.

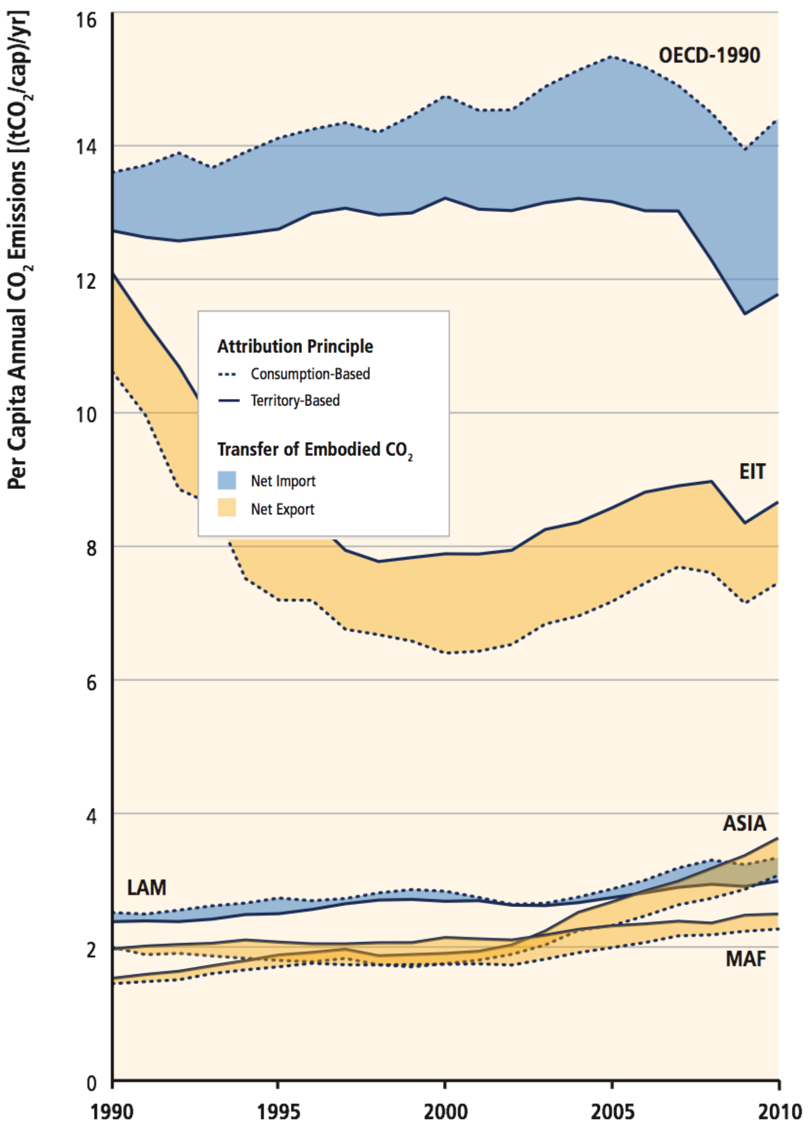


Sovacool, Benjamin K. and Marilyn A. Brown. 2010. “Twelve Metropolitan Carbon Footprints: A Preliminary Comparative Global Assessment,” *Energy Policy* 38(9): 4856-4869.

National Academies. 2016. “Pathways to Urban Sustainability”

Estimating Carbon Footprints is Inherently Geoscientific

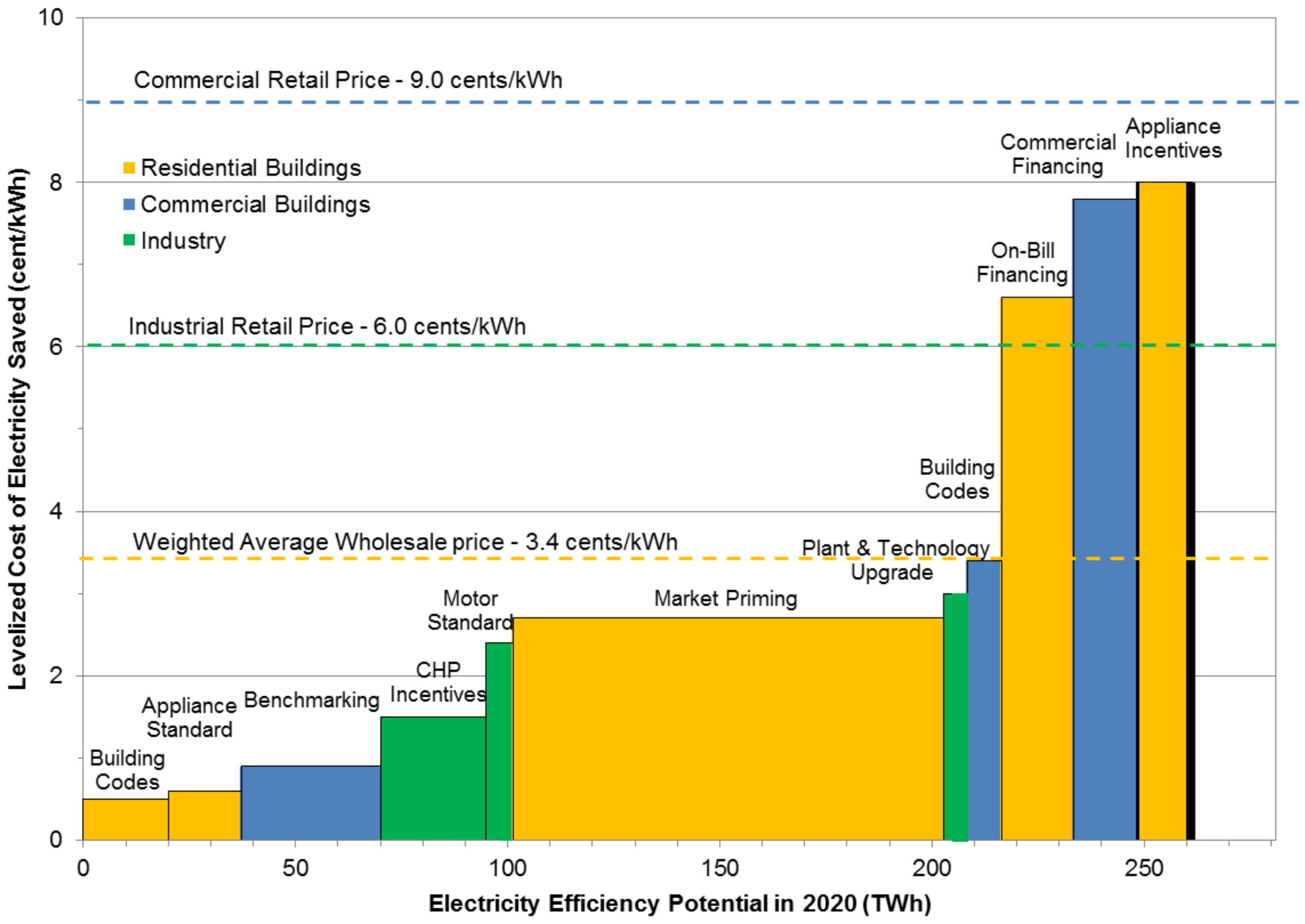
- Territorial based
  - Emissions within territories
    - Done primarily nationally
- Consumption based
  - Territorial emissions minus export emissions plus import emissions
    - High & upper middle income nations show large difference
    - Lower and lower-middle income nations show little difference
    - Emissions regulations in wealthier nations may push emissions to poorer nations



MAF=Middle East & Africa, LAM=Latin America
EIT=Economies in Transition

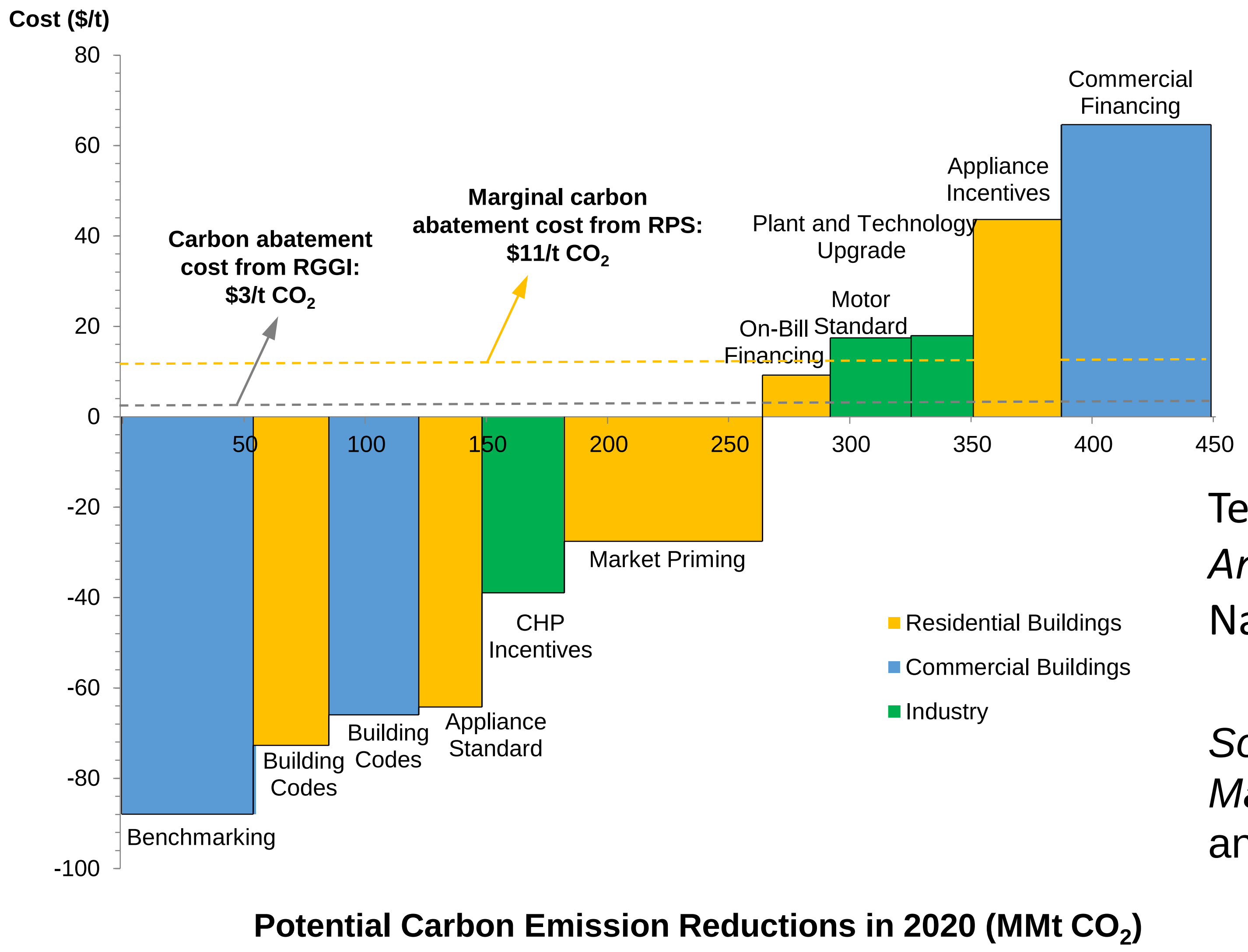
WGIII, Figure 5.14

Policy Supply Curves Merge Technology and Behavioral Insights



Source: Wang, Yu and Marilyn A. Brown. 2014. "Policy Drivers for Improving Electricity End-Use Efficiency in the U.S.: An Economic-Engineering Analysis". *Energy Efficiency,* 7(3): 517-546.

Potential Carbon Emission Reductions from 11 Energy Efficiency Policies



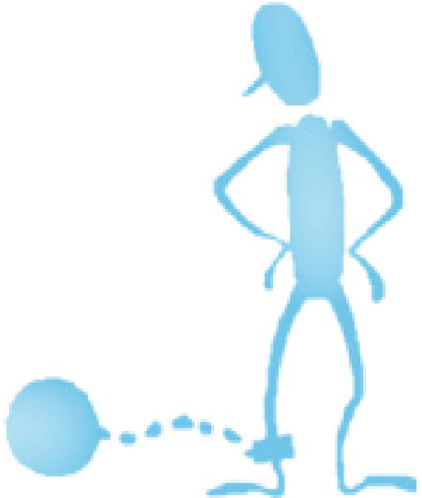
Technology supply curves were used in: *America's Energy Choices: Energy Efficiency,* National Academies, 2007-2009.

Source: Green Savings: How Policies and Markets Drive Energy Efficiency by M.A. Brown and Yu Wang, Praeger, 2015.

Behavioral Psychology and Economics Wrinkles

Consumers typically do not choose or use technologies following principles of rational utility maximization based on full information about the consequences of their energy choices

- Imperfect information, bounded rationality, loss aversion, rational inattention
- Social potential, the role of values, intermediaries



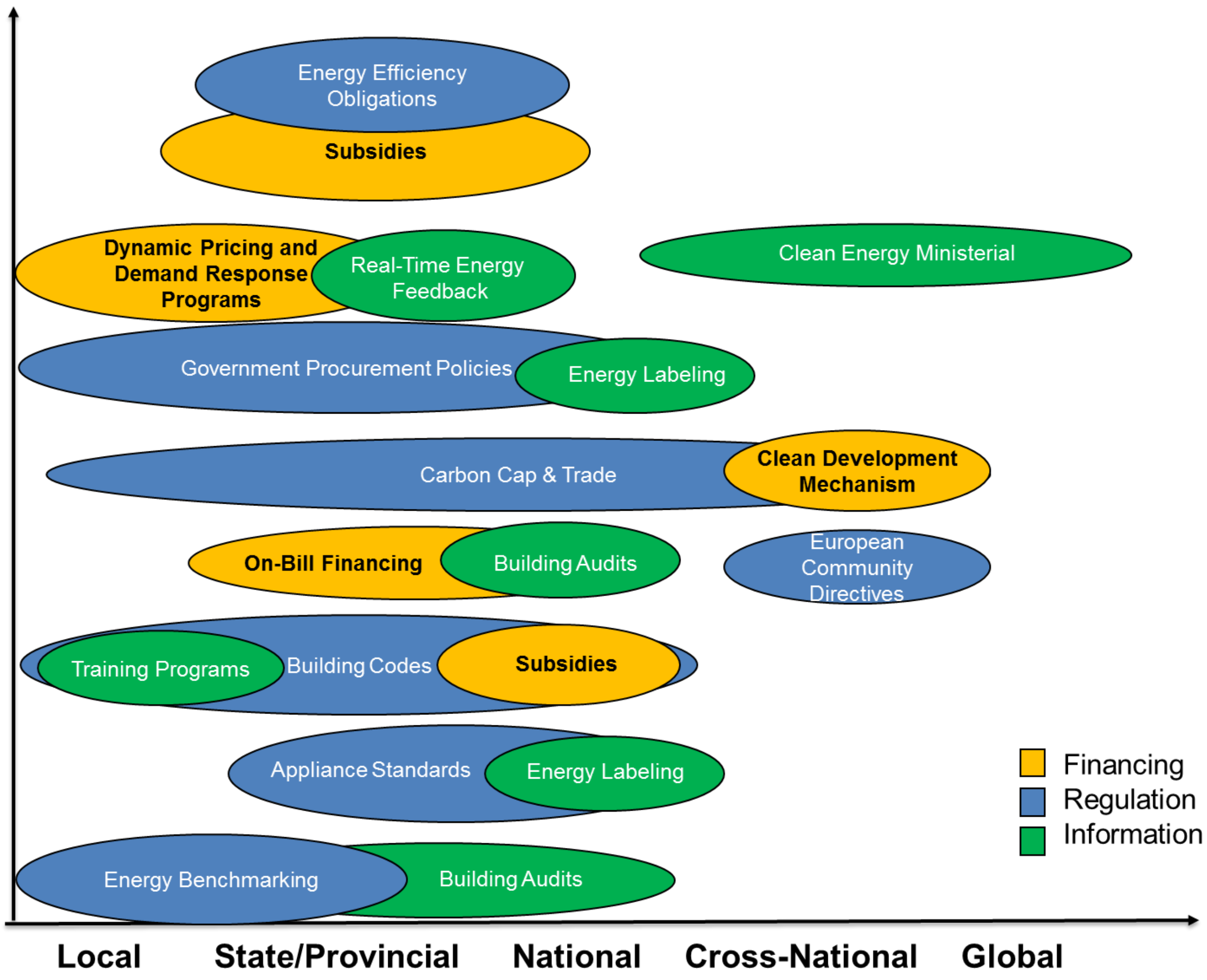
Policy Impacts Need a Spatial Overlay, Reflecting Multiple Scales of Governance

- The scale of policy implementation can be just as important as the choice of policy instrument.
- The division and authority for energy and environmental policy between the federal, state, and local governments has historically lacked a cohesive rationale.
- As a result, the integration of policies across multiple scales of governance has often been ad hoc.
- The case studies in Brown and Sovacool (2011) were chosen to illustrate effective coordination across scales of governance and stakeholders (i.e., “polycentrism”).

Geographic Scales of Policy Intervention

Favors Local/ State Policy	Local/State	National/Global
Diversity	Encourages innovation and experimentation in designing policy; provides diverse energy services that may be more responsive to changing needs	Stifles innovation and experimentation, is prone to diseconomies of scale, and changes slowly
Flexibility	More flexible and able to adapt to local conditions; reduces costs by connecting customers with local professionals; promotes administrative efficiency	More uniform and rigid; tends to fail to account for local conditions
Accountability	Allows for closer fit between policies and preferences and affords option to sort between jurisdictions	Promotes "rent seeking" behavior, which wastes resources trying to garner local advantages
Favors National/ Global Policy	Local/Regional	National/Global
Consistency	Building national markets for technology solutions is difficult when policies vary; local influence major appliance manufacturers and large consumers can be challenging	Standardization minimizes transaction costs and policy uncertainties; promotes inter-state trade of efficiency goods and services
Economies of Scale	Inefficient due to redundancies of R&D; evaluation, measurement and verification (EM&V) systems can be costly	Better matched to promote economies of scale and avoid redundancies; EM&V systems can be aggregated
Spillovers	Vulnerable to free ridership and emissions leakage; job creation may not be coincident with local investment	Minimizes free ridership and emissions leakage; accounts for dispersed non-energy benefits (e.g., green jobs)

Nested Policies:
From the Local to the Global Scale



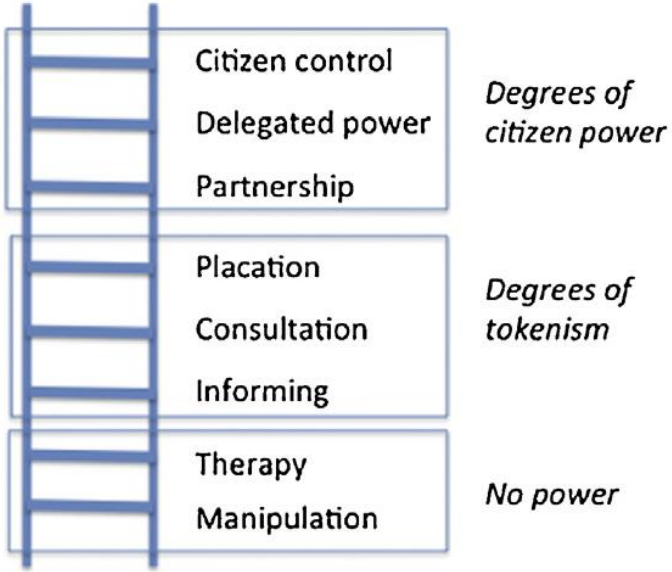
The Expansion of “Intermediaries” in Energy Markets

- Intermediaries have always existed:
    - Chambers of commerce
    - Professional and industry/manufacturers associations
    - NGOs, communities of faith
    - Homeowner associations
    - Bankers, insurers,…
    - Builders, architects,…
    - ESCOs, contractors,…
- They are expanding with privatization and technology diversification, they are expanding
- At the same time, the power of regulatory authorities is expanding (CPP, etc.)

Moss, T. 2009, Intermediaries and the governance of sociotechnical networks in transition. *Environment and planning. A* **41**, 1480-1495

Tap into the Creativity of People

- Move from “demand-side management” to “citizen engagement”
- Build communities of practice
  - Social media can assist
- Going beyond providers, users, and regulators
  - Top down, bottom up, don’t forget the “middle out” intermediaries



Ladder of Citizen Participation

Janda, K. B. Building Communities and Social Potential: Between and Beyond Organisations and Individuals in Commercial Properties. *Energy Policy* **67**, 48-55

Arnstein, S.R. 1969. “A Ladder of Citizen Participation.” JAIP, 35: 216-24.

For More Information

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